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FOREWORD

Many of today's most significant socioeconomic problems, such as slower economic growth, the decline of some established industries, and shifts in patterns of foreign trade, are inter- or transnational in nature. But these problems manifest themselves in a variety of ways; both the intensities and the perceptions of the problems differ from one country to another, so that intercountry comparative analyses of recent historical developments are necessary. Through these analyses we attempt to identify the underlying processes of economic structural change and formulate useful hypotheses concerning future developments. The understanding of these processes and future prospects provides the focus for IIASA's project on Comparative Analysis of Economic Structure and Growth.

Our research concentrates primarily on the empirical analysis of interregional and intertemporal economic structural change, on the sources of and constraints on economic growth, on problems of adaptation to sudden changes, and especially on problems arising from changing patterns of international trade, resource availability, and technology. In this paper R. Ballance considers fundamental changes in one of the most long-standing industries in the last two decades and emphasizes the need for a systematic evaluation of an industrial performance.

Anatoli Smyshlyaev
Project Leader
Comparative Analysis of
Economic Structure and Growth

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SHRINKING DEMAND IN AN AGEING INDUSTRY: THE CASE OF STEEL

Robert Ballance

1. INTRODUCTION

Because the demand for steel is a derived one which depends on conditions in steel-using industries, one appealing means of examining the industry's recent history is in terms of its links with these industries. Alternative approaches, for example those which highlight the technological dimensions of the industry's evolution, the impact of national policies related to the steel industry or other features, may be equally appropriate. In fact, the industry's difficulties are so complex and varied as to require analysis from a variety of viewpoints. Many of the salient problems are, nevertheless, 'demand-related' and readily lend themselves to a discussion couched in these terms.

Following a prolonged period of sustained growth and expansion, the industry's prospects changed drastically during the 1970s. The first section of this paper looks at some of the factors -- both domestic and foreign -- which have contributed to this transition by altering steel's relationships with its user industries. Among the domestic factors, fundamental changes in the composition of economic activity have diminished the industry's relative importance in many developed economies. The consequences of these macro-economic shifts have been compounded by industry-specific trends which have permanently reduced the dependence of steel-using industries such as automobiles, machine tools, shipbuilding or construction. The new vulnerability of many integrated steel producers can also be traced to international considerations. Relative changes in the global configuration of the steel industry have altered producers' links with foreign markets and their relationships with foreign competitors. Although the steel industry in all established centres of production has experienced considerable adjustment pressure, the nature of global shifts in production and trade have accentuated plight of the American and West European industries.

The second section looks at the change in domestic conditions in more detail. Statistical evidence documenting the fall in demand for steel products in major markets is examined. Major producers regarded the signs of decelerating demand as being merely a temporary aberration. Steel firms

maintained a generally complacent attitude towards their buyers and clung to an investment strategy which, in the longer run, accepted excess capacity as necessary in order to protect market share in times of maximum demand. A second, but equally important development which is emphasized in this section is the rapid emergence of small, non-integrated mini-mills. These new producers have captured as much as one fifth of some domestic markets and their share can be expected to increase significantly in the next decade. The success of mini-mills is partly explained by the cost advantages they enjoy relative to integrated producers. However, they have also developed much closer links with their buyers and this, too, has been an important reason for their progress.

The third section looks at some of the forces contributing to a growing internationalization of steel markets. With the possible exception of Japan, steel had traditionally been a 'home-bound' industry. However, following the slump in world demand for steel, many integrated producers were forced to turn to foreign markets in order to alleviate the problem of mounting excess capacity. Other factors, notably the growing variety of steel products demanded by users and a gradual decline in transport costs, also contributed to the heightened interest in exports. Steel exports, both direct and indirect (i.e., trade in steel-using products such as cars, tools, or machinery), rose. One consequence was that steel producers were further distanced from their buyers. And many of the larger integrated firms were slow to adjust to the new requirements expected of sellers in foreign markets. A major reason for this shortcoming is that the steel industry is not yet an international one in the same sense as many other mature industries are. Major steel firms are conspicuous by their reluctance to establish production sites in foreign markets. As steel-using industries such as automobiles and shipbuilding relocated during the 1970s, their steel contracts moved with them. Steel firms have only recently begun to respond to this danger, although their traditional home-market orientation coupled with their financial problems and vast size, continue to make the transition to a genuine international industry a difficult one.

1.1 Domestic Links with User Industries

The steel industry's domestic links with other fields of industry can be sketched from two different, but complementary, viewpoints. At the economy-wide level, today's major growth areas are quite distinct from those which were prominent prior to 1960. They include telecommunications, energy, aerospace and computers. Unlike the leading industries during the first two thirds of this century, these new fields are not intensive users of steel. In most developed countries, the demand for steel is dependent on a set of user industries which, themselves, are losing ground relative to overall economic activity. There are other structural changes that are equally broad in scope and have had similar consequences. Because the service sector's share in GDP in developed countries has tended to grow relative to the production of material goods, investment has given way to consumption in the expenditure of national income. Both services and consumption are less steel-intensive than investment in the production of material goods. Thus, the relative decline in the industry's share in domestic output and employment in many developed countries is likely to continue.

These macro-economic shifts have been re-enforced by industry-specific developments. First, technical advances have reduced the steel requirements of various industries. West German figures showing steel inputs per 1000 kg. of finished product suggest the significance of these advances for steel producers. During the 1970s, German steel requirements in the field of electrical machinery declined by 10 per cent and by 9 per cent in the case of rolling stock. The drop was even more abrupt in the case of shipbuilding where steel usage fell by 23 per cent, while for nuts, bolts, and similar products steel inputs were reduced by 11 per cent. 1/ Second, the emergence of new production techniques, combined with changing patterns of final demand, hastened the substitution of aluminium, plastics, and highly resistant glass for steel in many traditional uses. The substitution process was particularly rapid in the automobile industry. After 1975, the amount of steel per auto declined significantly.2/ For steel producers in North America and Western Europe, the difficulties created by substitution were compounded by rising auto imports or by downsizing of domestic models. In the case of the US these two initiatives, alone, are estimated to have cut the steel requirements of the American automobile industry by 8-10 million short tons per annum in recent years -- equivalent to 10 per cent of the US steel market.3/

While the impetus for these trends may differ, their consequences can all be depicted in terms of steel's links with its user industries. The economy-wide types of structural changes described above would not necessarily diminish the importance of the steel industry's role as a major supplier to other manufacturers or to other sectors such as construction and infrastructure. However, such fundamental shifts in economic structure will mean that the relative importance of steel within the manufacturing sector of developed countries will surely continue to decline. On the other hand, the types of industry-specific trends described have a more direct impact on the industry's economic relationships with its users. The new ability to economize on steel inputs and the inroads made by alternative materials will permanently alter the significance of the inter-industry linkages4/ which provided the basis for steel's steady expansion throughout most of this century.

By the late 1970s the net effect of these forces had unmistakeably diminished the industry's prospects. There had been a definite departure from the long-term growth trend that could not be attributed to cyclical factors or to the destabilizing impact of rising energy prices. In Japan, figures for the latest fiscal year (1983) show that only two of the five largest steel producers, Nippon Steel and Kawasaki Steel, were profitable. Similarly, just three of the six largest American firms reported profits in the first quarter of 1984 and much of this was from non-steel activities. Recent performance in other countries was equally dismal. The two major French firms, Sacilor and Usinor, lost $1.8 billion in 1983 while British Steel Corporation reported a loss of $191 million.5/ Explanations for this brutal reversal in the industry's performance are varied and extend beyond the types of domestic factors described above. The plight of some parts of the industry was greatly complicated by drastic shifts in the pattern of world production and trade which are examined below.

1.2 International Complications

Starting around 1870 the steel industry in most of today's rich countries embarked on a full century of growth and expansion, spurred by the construction of vast shipping fleets, railway systems and machines. In fact, the existence of a steel industry was generally regarded as a prerequisite for successful industrialization. The widespread importance given to the development of a national steel industry, coupled with expanding domestic demand, led to a gradual increase in the number of steel-producing countries. This steady upward trend was marred by occasional cyclical fluctuations, four of which occurred in the high-growth period between 1946 and 1970.[6] As the industry continued to expand, changes in the world steel hierarchy were occurring. The UK was the world's predominant steel producer prior to 1900 when it was replaced by the US. American leadership reached a zenith around 1920 when it accounted for 60 per cent of world production. Since then, the US share has steadily fallen, amounting to less than 12 per cent by the early 1980s. But until the 1970s buoyant demand meant that most major steel producers were not plagued by contractive problems arising from excess capacity, the threat of substitutes or declining profits.

Table 1 documents the changing map of world steel production since 1950. Two significant features can be noted. First, the shares of world production in Japan, Eastern Europe and other countries (mainly developing countries) have all risen. Together, the three groups of countries accounted for almost 66 per cent of world steel production in 1982. These gains occurred at the expense of producers in North America and the EEC. In the former instance, the relative contraction was an abrupt one although, for European steelmakers, it has been more gradual. A second important feature concerns the growth of world steel production. The level of world output fell significantly in 1975. After resuming its upward trend, output declined again in 1980 and continued its downward slide in later years. Both facts suggest that the contractive pressure on steel producers in North America and the EEC has been continuous and intense since the early 1970s. Latecomers like the USSR and Japan are now the premier steel producing nations. In 1983, these two countries accounted for 23 and 14.7 per cent of the world's crude steel production respectively.[7]

But the problems for producers in mature steel markets were not simply the result of a re-alignment in national productive capacities. Their position as leading exporters of steel was also eroded. Table 2 shows data on world steel exports which closely parallels trends in world production. In the three decades since 1950 the North American steel industry has been reduced to a minor exporter while the EEC has seen its share fall by more than one third. Again, the redistribution was mainly attributable to export gains in Japan, developing countries and socialist countries.

This brief overview is sufficient to suggest that conditions in the world's steel industries vary widely with the plight of the North American and European producers being the most serious. Ironically, if an assessment of world steel prospects had been carried out in the mid-1950s, it might well have noted several convincing reasons for steelmakers in both these regions to look forward to a long, if not indefinite, period of pre-eminence. The North American industry had been untouched by the war and could easily enlarge on

Table 1 World steel production, 1950-1982

Year	Shares in world total (percentage)						World total (thousand metric tons)
	North America	European Community[a/]	Other Western Europe	Japan	Eastern Europe	Other countries	
1950	47.9	25.5	2.1	2.5	18.9	3.1	190.0
1960	28.4	29.2	3.4	6.6	25.8	6.6	335.0
1970	21.9	23.2	4.1	15.7	26.2	8.9	594.0
1972	21.0	22.1	4.3	15.4	27.1	10.1	630.3
1973	21.5	21.5	4.2	17.1	25.5	10.2	698.4
1974	20.6	21.9	4.4	16.5	26.1	10.5	709.0
1975	18.4	19.4	4.6	15.8	29.8	12.0	645.5
1976	19.1	19.8	4.4	15.9	29.4	11.4	676.6
1977	18.8	18.7	4.3	15.2	30.2	12.8	675.7
1978	19.4	18.5	4.3	14.3	29.4	14.1	717.2
1979	18.6	18.8	4.5	14.9	28.0	15.2	747.6
1980	16.4	17.8	4.7	15.5	29.2	16.4	717.4
1981	17.6	17.7	4.5	14.4	29.1	16.7	707.5
1982	12.3	17.1	4.9	15.4	31.5	18.8	645.0
1983	13.3	16.4	5.0	14.7	29.6	21.0	662.6

a/ Figures for 1981-83 exclude Ireland.

Source: Production data for 1950, 1960 and 1970 from ECE (1976:19, annex). Data for 1981-83 from IISI (1984:3).

Table 2 World steel exports, 1950-1982

Year	Shares in world total (percentage)						World total (thousand metric tons)
	North America	European Community a/b/	Other Western Europe	Japan	Eastern Europe b/	Other countries	
1950	17.6	69.8	1.9	3.2	6.9	0.6	15.9
1960	8.6	64.5	6.1	5.4	13.2	2.2	40.9
1970	8.8	45.7	5.1	19.5	16.6	4.3	90.4
1972	4.0	48.6	6.2	20.4	16.2	4.6	102.3
1973	4.7	48.0	6.6	21.9	14.4	4.4	113.4
1974	5.5	48.2	5.5	24.7	12.5	3.6	130.4
1975	3.6	44.9	6.4	25.3	15.3	4.5	114.0
1976	3.4	40.7	6.7	28.9	14.8	5.5	124.8
1977	3.2	42.4	7.0	26.5	14.4	6.5	125.9
1978	3.7	44.1	8.5	22.6	13.4	7.7	137.1
1979	3.8	44.0	8.9	21.9	12.9	8.5	140.3
1980	5.3	42.7	8.8	21.5	13.1	8.6	137.8
1981	4.4	43.7	8.7	20.2	13.7	9.3	140.9
1982	4.0	39.7	9.4	21.7	12.9	12.3	132.0

a/ Figures for 1981 exclude Ireland.
b/ Includes inter-regional trade.
Source: see table 1.

existing capacity in order to maintain its position of world leadership. Although much of the European capacity had been demolished by 1945, the industry was rebuilding at a rapid pace and would not be encumbered by obsolete, pre-war capacities and technologies. More important, both regions had a long-established tradition in steel and could be assured that their regional markets would continue to account for the bulk of world demand. Despite these advantages, many American and European firms found themselves in a precarious situation by the mid 1970s. The following section looks at some of the domestic or internal factors which have contributed to this reversal.

2. INTEGRATED STEEL MAKING IN A NEW ENVIRONMENT

2.1 Contracting Demand and Expanding Capacity

The compilation of inter-industry data necessary to document the changing relationships between steel and its user industries would be a major undertaking which is beyond the scope of this paper. However, indirect evidence is available which provides strong evidence suggesting that the fall in demand for steel was, sometimes, a precipitous one. Table 3 shows trends in production and consumption for thirteen major iron and steel commodities and in three major steel-producing regions. The production data, although not directly relevant to the present discussion, confirm the importance of these major producers for the world steel industry. Production in EEC, where the contractive effects of demand were most evident, was between one eighth and one quarter of world total for the commodities shown in table 3. Together, the three regions supplied as much as one half of world production of many of these steel commodities and invariably accounted for more than one quarter of the total.

Data for 'apparent' consumption,[8] defined to be domestic production plus imports less exports, are more relevant to the present discussion. A fall in levels of consumption can be interpreted as a clear indication of a contraction of demand owing to a weakening of steel's linkages with its user industries and/or a shift in final demand away from steel-intensive activities. Levels of consumption declined significantly in many instances. Contractions were most pronounced in the EEC and for commodities at the earlier part of the fabrication chain -- pig iron, wire rods, angles, shapes and sections. Furthermore, for those commodities where levels of consumption did increase, the rise was often marginal and was by no means comparable with the corresponding growth of income or total manufacturing value added in those countries. Even Japan, which is touted to have the world's most efficient and dynamic steel industry, shows a decline in the consumption of several major items.[9]

A crucial factor in explaining the current plight of many American and European steel firms was their misjudgement of these trends as they began to emerge in the early 1970s. Firms incorrectly interpreted signs of decelerating demand as another cyclical aberration with no prolonged impact. Such attitudes were not implausible when placed in the longer term context of the industry's development. The industry was long accustomed to a pattern of expanding demand and had continually increased optimal plant size to take advantage of this trend. The first moves toward larger-sized units began as early as 1860 and, by 1900, annual plant capacity in many integrated iron and steel units was 100,000-200,000 tonnes. Plant size was continually expanded; in 1920, a typical rolling mill had an annual capacity of 600,000 tonnes. The

Table 3 Production and apparent consumption of iron and steel products, 1972-74 and 1979-1981

Iron/steel commodity (ISIC)	Production: World (in millions of tonnes)	Production: Shares in world (in percentages) 1972-1974 EEC a/	USA	Japan	1979-1981 EEC a/	USA	Japan	Apparent consumption (millions of tonnes) Annual average 1972-1974 EEC(6) a/	USA	Japan	Annual average 1979-1981 EEC(6)	USA	Japan
Pig iron (3710-07, 10)	482.6	20.5	17.9	17.6	17.0	13.4	16.2	104.6	86.8	85.9	91.4	69.7	84.4
Wire rods (3710-28)	43.8	25.1	10.5	14.5	22.1	9.2	13.3	9.8	5.9	5.0	9.8	5.1	4.6
Angles, shapes and sections (3710-35)	137.8	22.0	15.8	19.4	17.5	12.9	21.1	28.9	23.4	25.0	23.8	20.1	28.3
Heavy plates, over 4.75mm (3710-40)	69.2	19.3	...	23.9	17.1	...	17.5	12.2	...	13.3	11.3	...	11.3
Medium plates, 3 to 4.75mm (3710-43)	12.5	22.5	...	12.9	17.7	...	7.0	2.7	...	1.1	2.8	...	0.8
Plates and sheets, less than 3mm (3710-46, 49, 52)	194.2	19.8	31.6	29.5	20.5	15.0	36.2	34.5	...	55.6	32.9	27.1	...
Tinplate (3710-55)	14.8	28.1	38.7	12.7	27.8	32.4	12.6	3.0	5.8	0.9	3.1	4.8	1.0
Railway track material (3710-67)	9.9	13.3 b/	12.0	4.9	12.5 b/	12.7	4.8	1.0 b/	1.1	0.4	0.9 b/	1.4	0.4
Wire, plain (3710-70)	22.1	13.0 c/	12.8	15.4	12.7 c/	8.5	9.9	2.8 c/	3.3	2.9	2.7 c/	2.1	...
Tubes, seamless (3710-76)	20.0	20.4 b/	16.8	10.0	15.9 b/	15.5	15.6	2.4 d/	3.5	0.8	1.6 d/	5.4	0.9
Tubes, welded (3710-79)	32.7	21.7	14.3	19.8	17.6 b/	11.1	21.3	6.3	5.6	4.6	5.5 b/	6.5	5.2
Steel castings in the rough state (3710-85)	5.4	18.7	31.2	15.8	15.0	31.3	12.9	1.0	1.7	0.8	0.8	1.8	0.7
Steel forgings (3710-88)	7.5	13.2 b/	24.8	9.7	11.3 d/	23.7	8.3	0.9 b/	1.8	0.7	0.9 e/	2.0	0.7

a/ Belgium, France, Federal Republic of Germany, Italy, Netherlands and United Kingdom. Figures include intra-EEC trade.

b/ excluding Netherlands

c/ excluding Belgium, Italy and United Kingdom

d/ excluding Netherlands and United Kingdom

e/ excluding France and Netherlands

Source: United Nations, Yearbook of Industrial Statistics, commodity production, (various issues) and United Nations trade data.

Note: All figures are three-year averages. Apparent consumption is defined to be production plus imports less exports. For further discussion, see the statistical appendix to this paper.

advent of huge open pit mines and the later shift from open hearth furnaces to oxygen conversion hastened the move to larger unit size throughout the entire production process. Later, the Japanese were building integrated units with capacities of 3-10 million tonnes. Even after the demand for steel began to fall, massive investment programmes, typified by the British Steel Corporation's expansion programme and the French Fos development on the Mediterranean coast rolled on. Surprisingly, the rate of growth in steel capacity actually accelerated in 1975-77 although world demand peaked in 1974.

By the time the steel industry embarked on an 'involuntary' transition to maturity, it was predominantly composed of large, vertically integrated, firms producing a wide range of steel products. Significantly, the investment attitudes in the major firms was predominantly one of a "tons mentality" -- keeping excess capacity to protect their market share at times of maximum steel demand. This approach was a reflection of the industry's long experience during better times. Decisions were shaped by previous trends and comparatively little attention was given to an assessment of existing circumstances in user industries or the likely determinants of future demand. The consequences are vividly illustrated by the case of British Steel Corporation where, in 1971, the government endorsed plans to expand productive capacity to almost 40 million tonnes by 1980. Ironically, 1980 began with a tripartite dispute between government, industry and labour regarding a production level of 15-16 million tonnes. The extent of the misjudgement was compounded by mid-1982, when actual capacity was only 14 million tonnes.[10/] Essentially, many parts of the industry had lost contact with their buyers and were unable to accurately judge the consequences of steel's changing relationships with its users.

The cumulative effects of these miscalculations will take some time to redress. Steel capacity in OECD countries is currently about 600 million tons while consumption in 1984, which now appears to be a year of strong recovery, will probably not reach 440 million tons.[11/] The problem of overcapacity is acute in the EEC. Under pressure from the European Commission, steelmakers have agreed to reduce capacity by 26.7 million tons in 1985 which would mean that their total steel-making capabilities would be 142 million tons by the end of that year. But demand (European consumption plus net exports) is forecasted to be 109 million tons in that year, implying that the problem of excess capacity will persist in future years. Similar steps are being taken in the US where five per cent of capacity (i.e., 7 million tons) was shut in 1983 and an equivalent amount is planned for closure in the next two years. Likewise, in Japan, the world's biggest steelmaker -- Nippon Steel -- hopes to reduce its capacity by fifteen per cent in the next two years.[12/] But efforts to rationalize the industry have been slowed by the political problems they have raised everywhere, particularly in Western Europe and North America where reductions would be most substantial. These problems, in turn, have contributed to the strong protectionist measures, advocated by governments and industry strategists alike, as a means of delaying the necessary reductions in work forces and plant size.[13/]

2.2 Competition from New Sources: the Role of Mini-mills

Even if an accurate assessment of future demand had been available to investors in the mid-1970s, many firms would not have been in a position to adjust the level and composition of output accordingly. Investment costs had risen dramatically as plant size increased and the relative increase in these

expenditures meant that firms were heavily committed to the chosen technologies. A further complication was that steel makers had only a limited ability to make alterations in their production processes once new capacity was in place.

The lack of flexibility in adjusting to changing cost structures and shifts in market demand on the part of integrated steel producers created opportunities for new competitors in all traditional steel-producing centres. For example, small, non-integrated mini-mills, now appear to have irreversibly captured certain segments of the major producers' home markets. While the major producers mine their own ore, turn out a wide range of products and want to remain vertically integrated, mini-mills melt scrap to make steel, buy in supplies and are seldom unionized. These practices accord mini-mills significant cost advantages over their larger competitors, but they also have much more intimate contacts with steel users. Most began by focusing on narrow geographic market areas where they established close working relations with their buyers. Even those which have now enlarged the size of the market they serve continue to be highly specialized in the products they sell -- including seamless pipe, steel roofing and wire rod. This enables them to better adapt the product to the user's needs and to devote a relatively large portion of their funds to R and D. Mini-mills traditionally accounted for only a small portion of the domestic market -- 3 to 5 per cent of the US market in the 1960s. Primarily due to their cost advantages and intimate contacts with buyers, the market share of American mini-mills has soared in recent years and amounted to 18 per cent in 1983.[14/]

The successful development of mini-mills has eroded a major barrier to entry with the steel industry, the high cost of initial investment. A similar threat to integrated steel makers is posed by new production technologies which, as yet, are only in the developmental phase. If perfected, new production processes promise to reduce costs and optimal plant size. One example is 'thin slab casting' which is intended to cut the size of steel casters and the number of rolling machines required to produce sheet. Previously, investments in these machines cost as much as $500 million but may soon fall to as little as $10 million.[15/] These innovations will greatly reduce the capital costs that have helped to restrict entry into the steel industry.

3. INTERNATIONALIZATION OF THE STEEL INDUSTRY

3.1 Links with Foreign Markets

Long term shifts in patterns of domestic demand affected the direction and composition of world trade. In 1950, steel exports were less than 11 per cent of world production. However, this share rose steadily and, by 1982, exceeded 25 per cent of world steel production.[16/]. The growing variety of products demanded by steel users encouraged firms to expand their product ranges, a practice that boosted trade between steel-producing countries. Another significant trade stimulant was the emergence of excess capacity in several developed countries; after the slump after 1974, many large steel producers began to look to foreign buyers as a way to alleviate their problems. Finally, the demand for steel in the LDCs has steadily risen and, coupled with a long-term decline in transport costs, has contributed to the growth in world

steel trade. Thus, a large proportion of the steel producer's buyers were far removed from the producer. While this is a situation common to most modern industries, it was new for many of the tradition-bound steel firms.

Gradually, exporting came to play a more important role, particularly for the European industry where excess capacity was most serious. The significance of steel exports is suggested by the fact that, in 1976, steel consumption in the world's major markets was 49 million tons below the 1973 level and in 1979 it was still 34 million tons less than the original figure. But because producers had increased both their direct and indirect exports of steel, the corresponding declines in production were not so great. Relative to 1973, the drop in production was 34 million tons in 1976 and only 28 million tons in 1979.17/

Table 4 documents this trend, showing a steady increase in net exports as a share of production. By the end of the 1970s, total exports of steel (both direct and indirect) accounted for 18.8 per cent of production in the major steel producing countries. Although more recent figures (particularly with regard to net indirect exports) are not available, the upward trend appears to have continued in the 1980s. With regard to direct steel exports, table 5 shows changes in production levels and export shares for three major categories of steel products. A fall in the production of basic steel items (rods, angles, shapes and sections) occurred in several countries. However, trade in these items -- both imports and exports -- expanded steadily and, in fact, by 1981 exports accounted for 15 per cent of production among the countries shown. The growing importance of trade in steel products is equally obvious for the two other major categories shown in table 5.

The role of trade in steel products is, of course, influenced by the extent to which trade barriers have limited exports. As protectionist restraints on trade in steel products have proliferated, policy makers and strategists in a few countries -- Japan, South Korea and Taiwan -- turned their attention to indirect exports (i.e., ships, vehicles and machine tools). The figures in table 6 show the volume and composition of indirect steel exports of Japan, Western Europe and North America in various years. Clearly, indirect exports were of little significance in the case of North America; that region was a net importer of steel-using products throughout the 1970s. Although the volume of indirect steel exports from Europe was approximately two and a half times that of Japan in 1979, the latter's indirect imports were negligible. Measured in net terms, Japan's indirect exports grew rapidly and were comparable to European levels by the end of the 1970s.

The successful development of indirect exports of Japanese steel had several consequences as suggested by the changing distribution according to product groups. In 1962, the bulk of Japan's indirect steel exports were accounted for by intermediate steel products, rolling stock, and non-electrical machinery. That relationship had changed completely by 1979; more than 50 per cent of such trade was dependent on exports of the auto industry (passenger cars, commercial vehicles, and parts). The auto industry accounted for a much smaller share of indirect steel exports in Western Europe and North America -- 36.6 per cent and 30.4 per cent respectively in 1979.

Table 4. Production and net exports of major steel producing regions a/ selected years (in millions of metric tons of steel products)

	1962	1965	1970	1973	1976	1979
Production (in millions of metric tons of steel products)	173	224	287	337	303	325
Net exports of steel, b/ (as a percentage of production):						
Net direct exports	6.4	7.1	7.3	9.2	12.9	12.0
Net indirect exports	4.0	3.6	3.8	4.2	6.9	6.8

a/ Figures include the production and trade of Japan, North America, the European Community (excluding Greece), Austria, Spain, Sweden and Switzerland. Trade between the US and Canada is excluded.

b/ Net exports are defined to be exports less imports. Net indirect exports refer to trade in steel-using products (e.g. cars, tools, machinery).

Source: IISI, (1982:2).

Table 5 Production, imports and exports of iron and steel products, 1970 and 1981

	1970			1981			Percentage change 1970 to 1981		
	Production (in million of metric tons)	Imports (as percentage of production)	Exports (as percentage of production)	Production (in million of metric tons)	Imports (as percentage of production)	Exports (as percentage of production)	Production	Imports	Exports
Wire rods, angles, shapes and sections									
Belgium-Luxembourg	6.7	5.8	48.8	4.0	14.3	71.0	-4.5	3.6	-1.2
France	7.9	13.5	22.6	5.8	21.4	30.7	-2.8	1.4	-0.0
Germany, West	12.4	13.8	14.7	9.1	25.0	24.5	-2.7	2.6	1.9
Italy	6.2	9.0	2.2	9.7	5.8	8.8	4.2	0.1	17.9
Japan	26.0	0.0	5.8	37.5 a/	0.1	11.9	3.7 b/	14.1	10.4
Netherlands	0.8	109.3	31.3	0.5	139.6	49.3	-3.2	-1.0	0.9
Sweden c/	1.6	21.3	11.6	1.3	20.9	15.5	-2.3	-2.5	0.2
UK d/	7.9	1.1	7.8	5.0	7.8	19.5	-4.1	14.4	4.2
US	23.0	10.9	1.4	20.8 a/	12.3	1.8	-1.0 b/	0.2	1.1
Total of above	92.5	8.1	10.7	93.7	9.2	14.9	0.1	1.3	3.2
Plates and sheets, tinplate									
Belgium-Luxembourg	8.0	5.9	44.6	10.2	5.2	42.2	2.3	1.2	1.7
France	8.7	23.1	26.6	11.8	20.6	21.9	2.8	1.8	1.0
Germany, West	13.4	20.6	28.5	14.4	22.9	37.8	0.7	1.6	3.3
Italy	5.1	26.0	7.8	6.6	16.2	21.2	2.5	-1.9	12.2
Japan e/	3.0	0.0	43.4	3.0 a/	1.3	40.6	-0.1 b/	97.6	-0.7
Netherlands	2.5	29.3	47.6	2.4	29.9	62.4	-0.4	-0.2	2.1
Sweden	1.5	49.1	38.1	1.2	47.8	42.5	-1.6	-1.8	-0.6
UK c/	14.5	3.0	9.6	10.1	10.8	10.0	-3.3	8.6	-2.9
US f/	6.0	4.9	5.3	4.7 a/	5.9	8.7	-2.4 b/	-0.5	2.3
Total of above	62.7	13.9	23.7	64.4	15.6	28.6	0.3	1.3	2.0
Plain wire, tubes, seemless, tubes, welded									
Belgium-Luxembourg g/	0.4	30.2	61.6	0.3	63.1	119.0	-2.6	4.2	3.4
France	2.2	15.7	38.3	2.6	27.1	57.7	1.4	6.5	5.2
Germany, West d/	5.7	7.1	38.1	6.4	14.6	48.8	1.1	8.0	3.4
Italy g/	2.2	8.2	13.7	3.8	4.3	44.0	5.3	-0.6	17.1
Japan g/	7.7	0.0	33.4	12.3 a/	0.2	51.3	4.8 b/	19.9	8.5
Netherlands d/ h/	0.2	41.1	15.4	0.2	46.0	26.8	0.4	1.4	5.6
Sweden d/	0.6	37.0	40.5	0.5 a/	73.7	54.4	-1.7 b/	4.8	1.1
UK d/ i/	1.0	4.7	26.8	0.7	18.1	19.6	-3.0	9.8	-5.7
US	9.8	22.5	3.5	10.9	58.2	4.3	1.0	10.1	2.9
Total of above	29.8	12.2	23.6	37.7	23.7	36.9	2.2	8.6	6.4

a/ 1980
b/ 1970-1980
c/ Production data include additional related products.
d/ Production statistics do not provide for complete coverage.
e/ Only plates 3 to 4.75 mm and tinplate
f/ Only tinplate
g/ Excluding wire, plain
h/ Only wire, plain
i/ Only tubes, welded
Source: As in table 3. For further description, see the statistical appendix to this paper.

Table 6. The volume and composition of indirect steel exports by major producing regions,[a] selected years

	Japan			Western Europe			North America		
Trade in thousands of tons of finished steel equivalent	1962	1970	1979	1962	1970	1979	1962	1970	1979
Indirect exports	1092	4451	12019	9888	19037	30707	1886	2946	5499
Net indirect exports [b]	980	4231	11698	5764	8679	12228	507	(-1207)	(-1572)
By product group (as a percentage of indirect exports) [c]									
1. Non-electrical machinery	16.4	14.8	13.5	24.8	23.8	22.9	35.0	41.1	37.4
2. Electrical machinery and equipment	7.2	6.7	4.9	4.4	4.8	5.3	5.6	4.4	6.5
3. Agricultural machinery and tractors	0.4	1.0	1.7	5.8	4.6	4.1	7.9	7.2	6.4
4. Rolling stock	16.4	4.4	3.3	3.7	1.9	1.8	5.7	2.3	1.1
5. Passenger cars	2.9	18.2	25.7	20.5	22.4	18.4	18.6	5.6	7.4
6. Commercial vehicles	10.8	14.2	23.8	7.6	6.8	6.7	8.7	10.3	8.3
7. Motor-vehicle parts	2.1	2.4	5.0	5.1	8.9	11.5	0.0	12.4	14.7
8. Domestic appliances and equipment	1.8	1.7	0.9	2.6	3.1	3.0	2.8	1.4	2.6
9. Intermediate steel products	26.0	14.9	7.1	7.7	5.8	5.5	1.3	2.4	1.6
10. Other manufactureres	15.9	21.8	14.1	17.8	17.9	20.8	14.5	12.8	14.1

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a/ Country coverage is the same as shown in table 1.
b/ Indirect exports less indirect imports.
c/ Percentages may not add to 100 due to rounding.

Source: UNIDO (1983:284).

A successful tactic of expanding indirect exports of steel depends on close collaboration between the steel-using exporters and steelmakers themselves. Self-discipline is required of the latter group since an increase in steel exports could jeopardise the strategy. In general, a comparison of the regional figures for indirect exports, net indirect exports, and the industry composition of trade, all point to the fact that Japanese steel suppliers have been more effective in maintaining a much closer relationship with their domestic users than have European or North American producers. They have also benefitted considerably from the successful export programmes established by those industries.

At first glance it is tempting to attribute this result to the simple fact that Japanese automakers were far more efficient than their international competitors and the respective suppliers, i.e., the steel producers in each country, benefitted or suffered accordingly. Although that point is certainly valid, the actual causes are more complex and involve the attitudes of the steel suppliers as well as the competitive abilities of the respective automakers. Conditions in the US market are indicative of some of these problems. Until very recently, steel buying by US automakers had been an automatic process conducted with the reassurance of a familiar ritual. At the beginning of each year a supplier would be awarded a fixed percentage of the auto firm's needs for particular steels at particular plants. Automakers who wanted steel made to certain specifications was usually told that they would have to accept the tolerances of the American Iron and Steel Institute. Similarly, the auto industry was not interested to here from a steel maker who thought he had a better or cheaper way of doing things. As one analyst described the situation, "The steel companies' attitude was, 'We make steel. If you want it, buy it'. Conversely, the automakers' approach to suppliers was, 'You make the steel. Don't tell us how to make a car'".18/

3.2 The International Migration of Steel-using Activities

Although trade has gradually assumed a greater importance in the steel industry, integrated producers have long been conspicuous for their reluctance to establish production sites in foreign markets. One reason for the xenophobic attitude is that steelmaking was traditionally geared to meet domestic needs. Firms have yet to develop an international orientation that would be compatible with their new-found need to export. Another is that only a few steel firms -- mainly Japanese -- presently have the financial capability to pursue this alternative. And those that do have the necessary finances are hesitant to acquire existing facilities abroad owing to the antiquity of American and European steelworks.

In contrast, the automobile industry which is the major user of steel, has a long tradition of internationalization. It is, perhaps, a curious fact that soon after the first auto firms were established, they became multinational. By 1914, Ford had plants in Canada, France and the UK and only 15 years later that firm was assembling cars in no fewer than 20 countries.19/ General Motors followed suit and by 1928 was operating 19 plants in 15 countries. During the 1970s, the direction of migration in the automobile industry was away from established markets in the US, Canada, and the EEC to Spain, South Korea, Australia, Brazil, Argentina, Mexico, and other parts of South America. Smaller auto plants were also established in unlikely countries such as Indonesia, Morocco, Thailand, and Tunisia.20/

By the 1970s the consequences of this migration for domestically-based suppliers of steel in the major auto-producing markets was alarming. As the auto firms relocated, their steel contacts moved with them. Interestingly, the steel industry has not adjusted its own strategies to reflect its maturity in the same manner as other industries. In the case of bulk chemicals, for example, the intention to specialize in products of higher value added required firms to be more aware of significant market developments. Similarly, the increasing need to provide specific products for specific users -- a typical characteristic of many maturing industries -- entailed a greater emphasis on marketing aspects. Such trends meant that auto makers, chemical producers, and firms in other maturing industries became more intimately concerned with conditions in foreign markets. And as this 'service orientation' emerged, relocation to the consuming market was often a result.

There are some reasons to expect that the impact of migration by steel-using industries is lessening as new trade barriers (e.g., voluntary export restraints, and local content regulations) force the steel-using industries to locate production within the major consuming markets. Examples are the Toyota-General Motors agreement to start joint production in Fremont, California, the US-based production facilities of Honda and Nissan, Toyo Kogyo's (Mazda) links with Ford in Mexico, and Nissan's joint venture with Volkswagen. Significantly, Japanese steel producers have also begun to exhibit an interest in locating in the US market which parallels, to some extent, the Japanese-American linkages in the auto industry. The purchase by Nisshin of a modest stake in the US steel industry and the announced intention of Nippon Kokan (Japan's second largest steel producer) to acquire 50 per cent of another US firm attest to this new-found interest.[21] The major beneficiaries of this reversal will not necessarily be the original steel firms in the host country and the pressure on these firms to contract or exit from the industry will continue.

4. EPILOGUE

This paper makes no claim to have provided a complete picture of the determinants of the steel industry's relationships with its users. Obviously, any number of circumstances relating to factor markets, technological change, national policies and market structure can all have a bearing on these relationships. While each set of determinants would be important in their own right, they are typically considered in isolation and the cumulative effect on the industry's domestic and international position is thus obscured. Moreover, like several other ageing industries, the current steel crisis is partly attributable to circumstances which do not readily fit into the usual theoretical 'compartments' for analysis. The complacent or perfunctory attitudes which steel makers adopted towards their buyers provide an example of a non-economic phenomenon which contributed to the industry's problems. Another is the important role played by pressure groups within the steel industry in influencing government policy and industry strategies.[22] In general, the range and complexity of determinants which will influence an industry's 'economic health' probably widens as an industry develops. Ironically, however, the scope of industry analysis may narrow as the industry matures. To some extent this is understandable as analysts working within an industry are often obliged to focus on selected issues such as import penetration, financial capabilities, or the extent of foreign subsidies which have political or policy connotations. But for analysts and economists who

may enjoy the benefit of a perspective which is more remote from the industry's immediate problems, the usefulness of a more systematic evaluation of an industry in the broadest possible terms, including those sketched here, could be a rewarding and useful exercise.

APPENDIX: ESTIMATES OF APPARENT CONSUMPTION OF STEEL PRODUCTS

Estimates of apparent consumption were made at the most detailed level of commodity specification that was possible. United Nations statistics were the primary sources of data. The first step in the estimate of apparent consumption (defined to be production plus imports less exports) required the adoption of a concordance between ISIC and SITC rev. 1. Production data are reported in Yearbook of Industrial Statistics, vol. II at a 6-digit level of specification of the ISIC. Although the level of disaggregation exceeds the formal scope of the classification, a basis for an ad hoc concordance between the ISIC and SITC, rev. 1 is provided in the same publication.

While the use of detailed production data facilitated the task of matching equivalent items in the two classification schemes, several difficulties remained. Even at this level of disaggregation a simple one-to-one matchup between the ISIC and SITC, rev. 1 could not be made for a number of the commodities. In some instances, data for two or more SITC items were needed in order to concord with the appropriate 6-digit ISIC. In other cases, it was necessary to combine two or more ISIC items in order to obtain information that was consistent with the available trade data. And for a few commodities, multiple combinations of both SITC and ISIC designations were required. In each of these instances the concordance provided in the Yearbook of Industrial Statistics, vol. II was again helpful as it indicated when either the ISIC or SITC designation was a sub-component of the other. Nevertheless, a satisfactory match-up of the two statistical classifications could not always be obtained and the relevant commodities were excluded from the study. Table A-I shows the resultant concordance used in this paper.

In order to obtain an accurate and complete picture of international trends in steel consumption, it is important that the data include those cases where no domestic production occurs and consumption needs are met entirely through imports. Available production statistics, however, do not always distinguish between those instances where production either is zero or negligible and those where production has occurred but is not reported.[23/]

Table A-I Production-trade concordance for apparent consumption data used in this study

Commodity	ISIC	SITC, Rev. 1	Comments
1. Pig iron:		671.2	
from foundries	371007		
from steelmaking	371010		
2. Angles, shapes and sections	371035	673.4+673.5	Both sets of data refer to light and heavy sections.
3. Heavy plates	371040	674.1	More than 4.75 mm.
4. Medium plates	371043	674.2	3 to 4.75 mm.
5. Thin plates	371046 + 371049 + 371052	674.3	Trade data exclude strips.
6. Tinplate	371055	674.7	Trade data exclude tin-coated strips.
7. Railway track material	371067	676.1+676.2	Trade data include crossing pieces.
8. Plain wire	371070	677	Trade data include items made from purchased wire rod.
9. Tubes, seamless	371076	678.2	
10. Tubes, welded	371079	678.3	Trade data include tubes made from purchased iron or steel.
11. Rough steel castings	371085	679.2	
12. Steel forgings	371088	679.3	

If both these situations are treated in the same manner, the result would be occasional underestimation of consumption levels for countries that provide data on imports and produce the commodity domestically but do not report the latter. In order to safeguard against this result, various other statistical sources and journals concerning the industry were consulted.

Fortunately, a more extensive search of the relevant data has been carried out as part of a wider ranging UNIDO project.[24] Thus, when production was assumed to be zero, a further check was available through a search of the United Nations trade tapes. Aside from the possibility of re-exports, exports of a given item should be zero if domestic production does not occur.[25] A straight forward examination of the country's exports was not thought to be sufficient, however, since non-reporting may occur for both production and exports. Instead, the import data of all other countries contained in the United Nations trade tapes was searched to ensure that no potential trading partners reported imports of the given commodity from the country in question.

A similar problem arose in the compilation of associated trade data. Countries sometimes report only the value of import or exports but fail to figures indicating the corresponding volume of trade. Where possible, estimates of the volume of trade were made. The first step in this exercise was to calculate the unit value of the total trade flow, i.e., the per unit value of each country's exports and imports for each steel commodity and year where data was available. In those instances where unit values could be obtained for other years in either period (1972-1974 or 1978-1980), an average for available years was applied. These figures were then used to estimate the volume of trade for those years where only values were reported.[26]

Estimates of the volume of trade could often be made by using such means. However, there were a number of instances where the country provided no data on the volume of trade for any year in a particular period. Here, partner country data was used to calculate a unit value based upon figures reported by trading partners. In each instance, the estimated unit value was derived from trade for the specific country and product in question. Where no information was available to estimate a unit value, relevant quantum data was sometimes available in other sources. If not, these observations/countries were excluded.

A related problem occurred when no trade was reported (neither values, nor volume). In order to estimate apparent consumption, it is important to distinguish between instances of non-reporting and those where no trade -- exports, imports or both -- actually occurred. To safeguard against the erroneous conclusion that no trade took place (when, in fact, it did but was not reported) the data of all countries other than the one in question was examined to identify 'trading partners'. The first step in this exercise was to search the United Nations trade tapes of the 'rest of the world' in order to identify trading partners in every instance where a country's exports or imports of a particular commodity were not reported or were shown to be 'zero'. Where evidence of trade was noted, the data reported by partner countries was summed in order to obtain an estimate of the volume of non-reported trade. Thus, the imports (exports) of the world from (to) country X were regarded as country X's exports (imports) to the world.[27] The same conversion procedures and/or methods of estimating unit values, as described above, were sometimes required.

NOTES

1. UNIDO, Picture for 1985 of the World Iron and Steel Industry (ICIS, 161), p.18.

2. R. Ballance and S. Sinclair, Collapse and Survival: Industry Strategies in a Changing World, Allen and Unwin, London, 1983, p. 94.

3. Business Week, 20 August 1984, p. 87.

4. Steelmakers have also reduced their own usage of crude steel per unit of finished steel through technological advances and improvements in rolling and finishing but the net effect of these advances are less important than those stressed here.

5. See The Economist, 14 July 1984.

6. ECE, 1976, p.8.

7. IISI, World Steel in Figures, Brussels, 1984, p. 3.

8. Consumption is described as 'apparent' since the measure does not take account of changes in inventories. In order to smooth out inventory effects, three-year averages have been calculated.

9. Apparent consumption in Japan fell between 1972-74 and 1979-81 for five commodities and rose in four other items. Comparable data for both time periods was not available for four other commodities.

10. The Times, 8 June 1982.

11. Financial Times, 5 November 1984.

12. The Economist, 14 July 1984.

13. For a useful discussion of protectionist efforts in the steel industry, see K. Jones, Impasse and Crisis in Steel Trade Policy, Trade Policy Research Centre, London, 1983.

14. Business Week, 13 June, 1983.

15. Business Week, 24 September 1984.

16. Ballance and Sinclair, p. 106 and IISI, 1984, p. 13.

17. Based on Committee on Economic Studies, Indirect Trade in Steel - 1962 to 1979, IISI, Brussels, 1982, p.1. Major steel consuming markets are defined as in table 1.

18. Fortune, 16 May, 1983.

19. Maxcy, 1981, p. 69.

20. Although many of these relocations involved only assembly operations the net effects of the move away from traditional centres of production was significant.

21. If concluded, the latter acquisition would be the largest foreign direct investment ever in the US steel industry. Financial Times, 1 May 1984.

22. R. Ballance and S. Sinclair, 'Re-industrialising America: Policy Makers and Interest Groups', The World Economy, vol. 7, no. 2, June 1984, pp. 197-214.

23. In the primary source of production data, Yearbook of Industrial Statistics, vol. II, instances where zero or negligible production occurred are noted if some production actually occurred and was reported for at least one year during the entire period covered.

24. The results of this wider ranging statistical project are reported in UNIDO, 1985.

25. Imports of the commodity from a specific country (country X) does not ensure that domestic production of the commodity actually occurred in country X. This trade could have been re-exports from country X. However, there was no means to distinguish between those instances where the imports were national exports from country X and those where they were re-exports from the country. Thus, when at least one trading partner reported imports from country X, the assumption of zero domestic production in country X was rejected.

26. When unit values could be calculated for two of the three years in a period, an average was taken when estimating the volume of trade in the third year. If a unit value could be calculated for only one year, this figure was employed to obtain the estimated volume of trade in the other two years. Figures for one time period were not used to estimate a unit value for the other period.

27. It should be noted that the estimates which were derived using this procedure referred to general trade statistics, that is, exports including re-exports and imports including those for re-exports, rather than special trade statistics which would exclude re-exports.

REFERENCES

Ballance, R., and S. Sinclair. 1983. Collapse and Survival: Industry Strategies in a Changing World. London: George Allen and Unwin.

Ballance, R., and S. Sinclair. 1984. Re-industrialising America: policy makers and interest groups. The World Economy 7(2):197-214.

ECE (Economic Commission for Europe). 1976. Long-Term Prospects for Steel Consumption until 1985 and Outlook for 1980 and Past Trends in Production and Trade. Geneva: United Nations.

IISI (International Iron and Steel Institute). 1982. Indirect Trade in Steel - 1962 to 1979. Brussels: IISI.

IISI. 1984. World Steel in Figures. Brussels: IISI.

Jones, K. 1985. Impasse and Crisis in Steel Trade Policy. London: Trade Policy Research Centre.

Maxcy, G. 1981. The Multinational Motor Industry. London: Croom Helm.

UNIDO. 1980. Picture for 1985 of the World Iron and Steel Industry. Vienna:ICIS.161.

UNIDO. 1983. Industry in a Changing World. New York: United Nations.

UNIDO. 1985. Handbook of Industrial Statistics 1984. New York: United Nations.

United Nations. Various issues. Yearbook of Industrial Statistics, commodity production. New York: United Nations.

United Nations. Various issues. Yearbook of International Trade Statistics. New York: United Nations.

United Nations. Various issues. Commodity Trade Statistics, Series D. New York: United Nations.

United Nations. 1963. Commodity Indexes for the Standard International Trade Classification, rev. 2, add. 1. New York: United Nations.